DOCUMENT RESUME

ED 224 157 EA 015 249

AUTHOR Willms, Doug
TITLE Achievement Outcomes in Public and Private Schools: A Closer Look at the High School and Beyond Data.
INSTITUTION Stanford Univ., Calif. Inst. for Research on Educational Finance and Governance.
SPONS AGENCY National Inst. of Education (ED), Washington, DC.
REPORT NO IFG-TTC-9
PUB DATE May 82
GRANT OB-NIE-G-80-0111
NOTE 33p.; Prepared for the Tuition Tax Credit Seminar (Washington, DC, October 22, 1981).
AVAILABLE FROM Publications, Institute for Research on Educational Finance and Governance, School of Education, CERAS Building, Stanford University, Stanford, CA 94305 ($1.00).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Academic Achievement; *Catholic Schools; Educational Policy; *Educational Status Comparison; Family Income; Grade 10; Mathematics Achievement; Minority Groups; Outcomes of Education; Private Schools; *Public Schools; Racial Differences; Reading Achievement; *Research Problems; School Choice; Secondary Education; Socioeconomic Background; Statistical Analysis
IDENTIFIERS *High School and Beyond (NCES); National Assessment of Educational Progress; *Public and Private Schools (Coleman et al)

ABSTRACT

This paper analyzes data from the "High School and Beyond" study on approximately 30,000 sophomores in 1,000 U.S. schools. The purpose is to explain the contradictory conclusions offered by two recent national studies on public and private schooling. The analysis examines differences between public and private school students in mathematics and reading achievement along racial and social class lines and for students in different programs of study. The results show that there are no public/private differences for wealthier whites, those who are the main clientele of the private schools, and for students in academic tracks. However, for minority and disadvantaged students and for students in the general track, there are small but statistically significant differences, some of which are due to differential selection. Policy decisions should not be based on the assumption that private schools produce better achievement outcomes than public schools. (Author)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED224157

IFG

Institute for Research on Educational Finance and Governance

SCHOOL OF EDUCATION STANFORD UNIVERSITY

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

EA 015 249

TTC-9

ACHIEVEMENT OUTCOMES IN PUBLIC AND PRIVATE SCHOOLS: A CLOSER LOOK AT THE HIGH SCHOOL AND BEYOND DATA

Doug Willms*

May 1982

*Doug Willms is a Ph.D. student in the School of Education, Stanford.

This paper was prepared for the Tuition Tax Credit Seminar, Washington, D.C., October 22, 1981. The research for this report was supported by funds from the National Institute of Education (Grant No. OB-NIE-G-80-0111). The analysis and conclusions do not necessarily reflect the views or policies of this organization.

INSTITUTE FOR RESEARCH ON EDUCATIONAL
FINANCE AND GOVERNANCE

The Institute for Research on Educational Finance and Governance is a Research and Development Center of the National Institute of Education (NIE) and is authorized and funded under authority of Section 405 of the General Education Provisions Act as amended by Section 403 of the Education Amendments of 1976 (P.L. 94-482). The Institute is administered through the School of Education at Stanford University and is located in the Center for Educational Research at Stanford (CERAS).

The research activity of the Institute is divided into the following program areas: Finance and Economics; Politics; Law; Organizations; and History. In addition, there are a number of other projects and programs in the finance and governance area that are sponsored by private foundations and government agencies which are outside of the special R&D Center relationship with NIE.

Abstract

This paper analyzes data from the High School and Beyond study on approximately 30,000 sophomores in 1,000 U.S. schools. The purpose is to explain the contradictory conclusions offered by two recent national studies on public and private schooling. The analysis examines differences between public and private school students in mathematics and reading achievement along racial and social class lines and for students in different programs of study. The results show that there are no public/private differences for wealthier whites, those who are the main clientele of the private schools, and for students in academic tracks. However, for minority and disadvantaged students and for students in the general track, there are small but statistically significant differences, some of which are due to differential selection. Policy decisions should not be based on the assumption that private schools produce better achievement outcomes than public schools.

Recently there has been considerable debate among educators concerning public policy toward nonpublic schools. This debate is reflected in proposals to give public financial support to private schools through voucher mechanisms or tuition tax credits. Opponents to the proposals argue that private schools are inequitable along racial and social class lines, and that they do not serve the goals of education for a democratic society. Advocates believe that such mechanisms will provide greater parental choice and therefore promote competition among schools, challenging them to provide greater diversity and responsiveness to students' educational needs and more rigorous academic training. Central to this debate is the question of whether private schools are currently more effective than public schools in terms of educational achievement.

Two national studies on public and private schools have been conducted during the past year to address this achievement issue. Unfortunately, the reports provide disparate conclusions:

> . . . in general, with [family] background characteristics controlled, Catholic school sophomores perform at the highest level, sophomores in other private schools next, and sophomores in the public schools lowest.[1]

> When populations are equated for socioeconomic status, the mean differences between public and private schools diminish considerably or vanish. There is no statistically significant private school advantage nationally, at any age, in either reading or mathematics.[2]

The contradictory results are perplexing, since both studies examine mathematics and reading achievement for large comparable samples. The first report (Coleman et al.), sponsored by the National Center for Education Statistics, was based on a national sample of 59,000 high school seniors and sophomores in 1,000 U.S. schools. The sample was the first wave of the longitudinal High School and Beyond (HS&B) study conducted by the National Opinion Research Center. The second report, sponsored by the National Institute on Education and conducted by the National Assessment of Educational Progress (NAEP), was based on a sample of 104,000 nine, thirteen, and seventeen year old children from 1,377 schools. NAEP has collected achievement data on U.S. school children for 11 years; however, their report was also based on only the 1980 cross-section.

One possible explanation for the different results is different statistical methodology. The results of both studies depend on adequate statistical control for family background differences between students in the public and private sectors. The studies do differ in the variables used to control for family background and in the statistical models employed.

The purpose of the present study is not to criticize one study and champion the other. Rather, its purpose is to present further analyses that explain the discrepancies of the two studies and to answer two policy questions relevant to the tuition tax credit debate. First, if there are differences in academic performance between the public and private sectors, are these differences uniform for all students, or are they patterned along racial and social class lines? For example, it is

conceiveable that children from advantaged backgrounds do equally well in either the public or private sectors. On the other hand, minority and disadvantaged students may perform considerably better in the private schools, either because they respond differently to different educational practices or because private schools are markedly better than the larger inner city public schools that most of these students attend. If such a relationship exists, then a policy which is primarily directed toward advantaged families will have little effect on overall student performance. However, such findings would suggest a need for a policy that encouraged greater participation of disadvantaged students in private schools or improvement in the public schools that predominantly serve these students; in the latter case, the improvement might be accomplished by emulating the conditions and practices of the private schools.

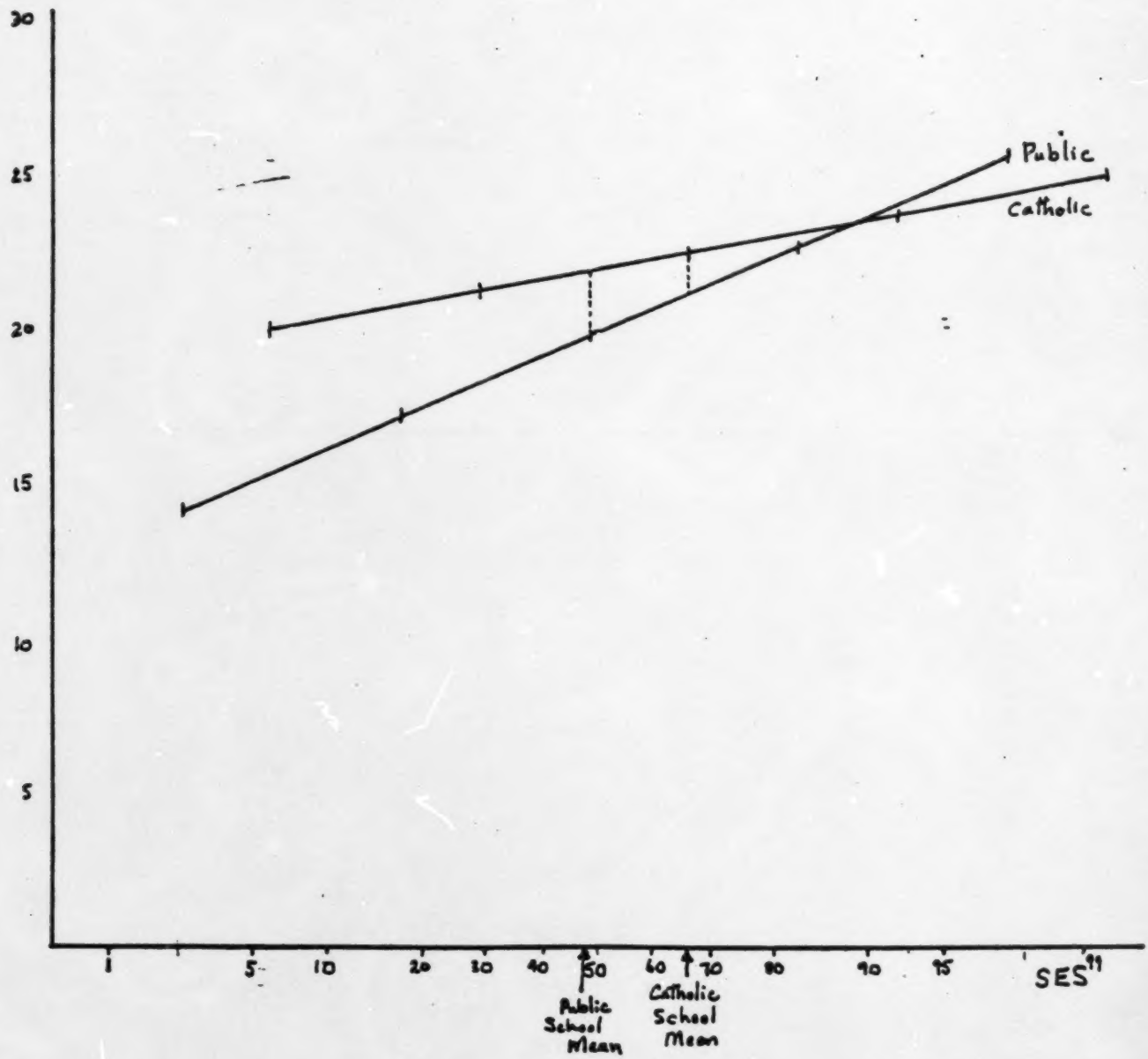
The second policy question is whether, for students enrolled in the same course of study, there are differences in academic achievement between those in the public and private schools. Most large public high schools offer different programs of study, generally categorized as academic, general, or vocational. A student's program is determined somewhat by previous academic performance, but also by student and parental choice. Another choice is private schooling; however, most private schools offer only academic programs. Many parents opt for private schooling and will bear considerable expenses in the belief that their child will receive better academic training. Is this belief well-founded?

Part I: Public/Private Differences Along Social Class and Racial Lines

The first analysis is directed toward determining whether the differences in academic performance between the public and private sectors is a function of socioeconomic background. The most common statistical model for determining group differences (ANCOVA) is not appropriate for addressing this question; it requires the assumption that the effect is the same for all students, regardless of race or family background. The model used in this analysis[3] tests this assumption and allows for separate estimates of private schooling effects for students with different backgrounds. Data on sophomore[4] achievement in public and Catholic private[5] schools from the HS&B file were used for this analysis.

The results show that achievement differences between public and private schools do differ along racial and social class lines. The difference in public and private reading performance favors Catholic students overall, but this difference decreases at higher levels of parental income, and is greater for blacks than for whites (see Appendix 1). A similar relationship holds for mathematics scores, with the public/private differences decreasing with higher levels of parental education (see Appendix 2).

Figure 1 shows this relationship graphically. The regression lines for mathematics scores on socioeconomic status (SES) are shown for the public and Catholic sectors. (SES is a composite of five variables



Sophomore Mathematics Scores by Socioeconomic Status Percentile

related to race, income, and parental education; percentiles for the total sample are shown on the horizontal axis.)[6] If one considers higher SES students, say those above the 50th percentile, the achievement differences are negligible; at lower levels of SES they slightly favor Catholic students, at upper SES levels they slightly favor public students. For lower SES students, those below the 50th percentile, differences favor Catholic students by about one-half of a standard deviation, enough to move a child from the 30th percentile to the middle of the class. However, this difference is probably an over-estimate because the SES composite does not provide a complete control for family background differences. One should also note that only about 30 percent of the Catholic students are from this lower SES group, and that differences are less for reading than for mathematics.

By further examining Figure 1 we can postulate why the Coleman, Hoffer and Kilgore results differed from those of NAEP. Coleman, et al. reported their differences for the average public school child (vertical distance between regression lines at the public school mean on Figure 1). NAEP used a technique[7] equivalent to reporting the difference for the average private school child (vertical distance between the regression lines at the Catholic school mean on Figure 1). The difference Coleman, et al. found was small but statistically significant, the difference NAEP found was also positive, but too small to be statistically significant because of the sample size.

Therefore, in reporting achievement differences between public and private schools, one must specify which group is being considered. Based

on the regression results of this section, the public/private difference in mathematics for the most advantaged whites is about three-eighths of a standard deviation, favoring public school students; for the most disadvantaged blacks, the difference is about seven-eighths of a standard deviation, favoring Catholic school students.

PART II: PUBLIC/PRIVATE ACHIEVEMENT OUTCOMES BY ACADEMIC STREAM

Early in their high school career, students enter vocational, general, or academic programs. A child's program is determined by a number of factors, including previous grades, aspirations, and choice (Davis and Haller, 1981). Students with higher initial ability and students with higher SES backgrounds more often choose an academic program in preparation for college (Alexander and McDill, 1976). In addition, many schools have formal or informal achievement criteria denying access to academic programs for many students. Therefore, even before the effects of a more academic oriented curricula can affect student performance, students in the academic track have been pre-selected initially on variables strongly related to achievement test performance.

The proportion of students in each academic track is not the same for public and private schools. In the public schools approximately 41 percent of the students are in academic programs, 36 percent in general programs, and 23 percent in vocational programs; compared to 76 percent, 17 percent and 7 percent for the Catholic sector.[8] As a consequence of this disparity alone, we would expect the average Catholic school child to

show higher achievement test scores. Therefore, one must ask, "are there achievement differences between public and private students enrolled in the same academic program?" This question is also of substantive interest to parents in deciding upon the merits of bearing the additional expense of private schooling.

To address this question, mathematics and reading scores were estimated for students from each academic stream for both sectors. Observed and adjusted[9] differences are shown in Table 3.

Even before they are adjusted for family background differences the mathematics and reading achievement scores for academic stream students vary by only about a tenth of a standard deviation between sectors. After adjustment for family background differences there are not statistically significant differences between students in the public or Catholic sectors.[10]

A further analysis whereby estimates for some of the missing income and parental education values were imputed, showed the differences to be less: 0.106 for reading, -.151 for mathematics. We also requested the NAEP staff to provide a similar analysis of the NAEP data. Their results confirmed our findings: after adjustment for demographics the public/private difference in reading was only 1.0 percentage points favoring the private sector, with a standard error of 1.9,[11] for a difference that is insignificant statistically.

For students in the general studies track there are significant differences ($p<.01$) in both mathematics and reading achievement with Catholic students faring better by approximately one fifth to one quarter

Table 3

Reading and Mathematics Scores by Academic Stream
(HS&B Sophomores)

Stream	Catholic mean (std. dev.)	Public mean (std. dev.)	Observed Difference	Adjusted Difference
READING TEST				
Academic	11.509(3.49)	11.077(3.82)	.432**±.237	.226
General	9.305(3.51)	8.472(3.38)	.833**±.460	.574**
Vocational	8.735(3.59)	7.954(3.30)	.781* ±.717	.305
MATHEMATICS TEST				
Academic	23.341(6.27)	22.868(6.93)	.473* ±.430	-.007
General	19.511(6.01)	17.150(6.31)	2.361**±.860	1.796**
Vocational	18.123(6.41)	16.291(6.25)	1.832**±1.353	.795

Note: Sample sizes for the reading test were as follows:

1162/217/85 for the Catholic sector (academic/general/vocational),
6092/4261/2441 for the public sector.

Sample sizes for the mathematics test were as follows:

1156/216/85 for the Catholic sector,
6053/4223/2406 for the public sector.

* $p < .05$
** $p < .01$

of a standard deviation.[12] However, it is likely that these estimated differences are inflated. They are a result, to some degree, of selection bias; that is, that private schools mainly get students who have higher initial ability, are better disciplined, and come from families that have high expectations and provide considerable encouragement and support. These students would perform well in any type of school. In one attempt to control for selection bias using Heckman's approach,[13] Coleman found that the public sector scores were about fifteen percent of a standard deviation higher.[14] Furthermore, only five background variables were used in the adjustment compared to seventeen in the Coleman et al. report; the shorter list was used to avoid the severe problems of missing data encountered in their analysis. This shorter list of control variables is inadequate to account for all of the selection effects. The most important control variable, academic achievement prior to entering high school, is not available in the data set. With more adequate controls, the observed quarter of a standard deviation difference may vanish altogether.

The vocational stream estimates do not deserve much attention. They are relatively unstable due to the small number of Catholic students in vocational programs. NAEP had the same problem with small numbers of private students in both general and vocational programs.

From these results, we can draw the following conclusions:

1. For academic stream students private schooling in Catholic or other private schools has no effect on reading or mathematics achievement.

2. For general stream students, Catholic school students perform better than public school students by about one quarter of a

standard deviation. This estimate should be considered an upper bound due to the unmeasured effects of more favorable student selection for the Catholic schools.

DISCUSSION AND SUMMARY

In Part I we observed that there are no differences in academic achievement between public and private schools for advantaged whites. Tuition tax credits that primarily induced migration of white upper class students from public to private schools would not raise the overall levels of school achievement. The data also showed that there are small but significant differences in academic achievement for disadvantaged and minority students. There are two possible explanations for these observed differences.

The first explanation is that the differences are mainly due to selection bias, and that selection bias increases with lower levels of student socioeconomic background. There are three reasons why this is a plausible explanation. First, private schools usually have some type of admission criteria, either formal or informal, in terms of both academic achievement and school related behavior. For a group of minority students from low income families, only a small percentage meet these criteria, generally the highest achievers. For advantaged whites, on the other hand, a large proportion meet the admission criteria and achievement-related variables do not play as big a role in the selection process. Second, many disadvantaged students select public schools in order to attend job-oriented or special education programs. Their achievement scores weigh down the public school achievement scores. Third, many

private schools offer scholarships only to high achieving disadvantaged students, enhancing private school achievement scores for this group through scholarship selection. Therefore, even if there were no differences in actual school effects, we might still expect the relationship of achievement to socioeconomic background to be similar to the pattern in Figure 1.

The second explanation is that there are marked differences in the types of schools that serve minority and disadvantaged students in each sector. A substantial portion of disadvantaged and minority public school students are in large, overcrowded inner city schools that offer predominantly general and vocational programs. For example, of the schools sampled in the High School and Beyond Data that were serving over 25 percent blacks, 56 percent of the Catholic schools offered academic courses of study to at least 75 percent of their students, compared to only 10.4 percent of the public schools. Enrollment in the Catholic schools ranged from 212 to 1,356 with a median of 560; the public school median was 1,787, with over one third of the schools enrolling over 2,000 students, the largest with 4,300. Catholic schools are very different from public schools in both school program and size.

If we accept that observed differences are due only to selection effects, then any policy that attempts to transfer students from public to private schools will be ineffective in raising test scores of disadvantaged and minority students, since the students transferring will not be comparable to those who presently attend private schools. However, if we accept the second explanation, test scores for disadvantaged and minority students might increase through greater participation of these

students in the private schools, or by introducing improvements in the large inner-city schools that emulate features of the private schools. Therefore, it is important to do further analyses to understand the likely origins of test score differences between public and private schools for minority and disadvantaged students.

Previously, we noted that when we control for student track, the largest apparent effect in favor of student achievement for Catholic schools was found for mathematics results for students in the general track. That difference is one quarter of a standard deviation. When sample sizes are of the order of several thousand students, the statistical significance of the treatment effect is less important than its actual size. Accordingly, it is important to assess the social significance of one quarter of a standard deviation in test scores. Meyer and Wise (1979) examined the relationship of high school test scores and wage rates in the first four years after graduation for male youths in the 1972 NCES National Longitudinal Study, another major national research endeavor. They report:

> A standard deviation increase in the test scores total is associated with an average of estimated wage rate increases over the five periods of about 3 percent (p. 59).

On the basis of these results, a reasonable prediction is that general stream Catholic students, with their one-quarter standard deviation advantage, would earn only five to ten cents more per hour after high school than their public school cohorts.

It is useful to summarize these analyses of the two sets of data. First, policy decisions should not be based on the assumption that either public or private schools produce better achievement. Clearly, some public schools are better than some private schools, and vice versa. However, there are no observed differences in achievement for advantaged white students, those who are most likely to attend private schools. Although minority and disadvantaged students in private schools do perform better than those in public schools, at least some of these differences are due to differential selection. An important topic for future research is to make a more precise assessment of school effects as opposed to selection effects in order to understand how to improve the achievement of minority and disadvantaged students.

NOTES

1. Coleman, J. S., T. Hoffer, and S. Kilgore, "Public and Private Schools," Report to the National Center for Education Statistics under Contract No. 300-78.0208 by the National Opinion Research Center. Draft dated March, 1981, p. 173.

2. National Assessment of Educational Progress, Reading and Mathematics Achievement In Public and Private Schools: Is There A Difference? Report No. 54-RM-50 (Denver: Education Commission of the States, June 1981).

3. Mathematics and reading achievement can be estimated for each sector, public and Catholic, by two separate regressions:

$$\begin{aligned} Y_j &= \alpha_p + \beta_p X_j + \varepsilon_j \qquad && j = 1, \ldots n_p \\ Y_j &= \alpha_c + \beta_c X_j + \varepsilon_j \qquad && j = n_p + 1, \ldots n_p + n_c \end{aligned} \tag{1}$$

where X_j are vectors of background variables, β_p and β_c are regression slope vectors, and ε_j is error (assumed IND $[0, \sigma_\varepsilon^2]$). It is common to assume that the two regression slopes are parallel, that is $\beta_p = \beta_c$, and test for treatment effects using analysis of covariance (ANCOVA):

$$y_j = \alpha + \beta_z Z_j + \beta_1 X_j + \varepsilon_j \tag{2}$$

where Z_j is a dummy variable denoting 'treatment' status, public or private. β_z is then the public/private difference (treatment effect) of interest, and is estimated using ordinary least squares. If the regression slopes are not parallel, then it is necessary to add interaction terms to the model:

$$Y_j = \alpha + \beta_z Z_j + \beta_1 X_j + \beta_2 Z_j X_j + \varepsilon_j \qquad j = 1, \ldots n_p + n_c \qquad (3)$$

which is an equivalent expression for equation 1 (see Rogosa, D. R. "Comparing Non-Parallel Regression Lines". Psychological Bulletin, 1980, 88, 307-321).

The first part of the present analysis was to test whether the regression slopes are indeed parallel, which would indicate that public/private differences are constant over varying income levels and over different ethnic backgrounds. To test for this interaction, the full ANCOVA model (equation 3) was tested for both mathematics and reading:

$$Y = \beta_0 + \beta_z Z + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_{z1} X_1 Z + \beta_{z2} X_2 Z + \beta_{z3} X_3 Z + \beta_{z4} X_4 Z + \beta_{z5} X_5 Z + \varepsilon_o$$

where Y = the number right on the reading test (YBREADRT, 19 items) or the mathematics test (YBMTHIRT + YBMTHZRT, 38 items);

Z = treatment dummy for school sector (Z = 0 if public, Z = 1 if Catholic private);

X_1 = family income (BB101, 7 categories);

X_2 = father's education (BB039, 9 categories);

X_3 = mother's education (BB042, 9 categories);

X_4 = race (X_4 = 1 if black, X_4 = 0 if white); and

X_5 = race (X_5 = 1 if hispanic, X_5 = 0 if white).

The sample included all those sophomores for whom there was complete information on the five covariates and the selected dependent variable (reading or math). There is a substantial amount of missing data in the entire HS&B file. Analyses were attempted by constructing the correlation matrix using both "listwise" and "pairwise" deletion (Nie, Hall, Jenkins, Steinbrenner, and Bent, 1975, p. 283), as well as attempting to impute missing values from other variables. None of these other approaches improved the analysis substantially and did not alter the direction of the results. The "listwise" approach was chosen since the degrees of freedom can be determined in a straightforward manner.

The HS&B sample design weights were used in the analysis, but the degrees of freedom were determined by the actual number of cases in each regression. Several analysts have suggested that the correct unit of analysis should be the school, not the student. In the HS&B design, students were selected in the second stage of a two-stage stratified probability sample, and so the number of schools may be more appropriate; however, as Page and Keith (1981) have pointed out, the question is "largely mooted by the large samples available in the HS&B data, both of students and of schools." (p. 16). The reader should bear this in mind when interpreting the significance of the reported tests, and is

encouraged to focus attention on the size of reported differences, not on their statistical significance.

Results of these two regressions are shown in Appendices 1 and 2.

4. Public/private differences reported by Coleman et al. were less for seniors than for sophomores. They argue that the difference is less because many low achieving public school students drop out of school before becoming seniors, therefore improving the average public school senior score. Sophomores were chosen for analysis in this study in order to determine an upper bound for achievement differences and to avoid the above attrition argument.

5. In a previous analysis "other private" schools were included in the analysis. Since there were only 27 schools in this sector, the power of most of the tests was relatively low and so these schools were dropped from the sample.

6. The SES variable is the first principle component of the five covariates used in this analysis. The principle components analysis and regression results are shown in Appendix 3.

7. National Assessment of Educational Progress. A Brief Description of NAEP Analysis Procedures. Denver, CO: Education Commission of the States, June 1981.

8. Defining academic stream was difficult. Item BB002 (HS&B student file) asks:

Which of the following best describes your high school program?

General
Academic
Vocational
- Agricultural occupations
- Business or office occupations
- Distributive education
- Health occupations
- Technical occupations
- Trade or industrial occupations

Based on this item students distributed themselves as follows in the three academic streams:

	Academic	General	Vocational
Public	29.5%	48.0%	22.5%
Catholic	61.3%	31.5%	7.2%
Private	55.8%	40.1%	4.2%

The large number of general stream Catholic and private students led us to suspect that a large number of students responded to the high school program item by choosing the first response, "general" stream. Using the principals' estimates of the percentage of students in each academic stream and information on the school sizes, the estimated percentages of students in each academic stream is as follows:

	Academic	General	Vocational
Public	39.0%	41.8%	9.2%
Catholic	75.6%	19.0%	5.4%
Private	74.3%	11.8%	13.8%

The biggest discrepancies between student responses and principal's estimates were for the academic and general stream responses. We had hoped to identify academic stream students by the courses they had taken but the HS&B items on courses completed are not detailed enough for this purpose. Therefore, we defined children as being in the academic stream if they indicated "academic" on BB002 or if they planned to attend a four year college or university in the year immediately following high school (response 8 to item BB071). Otherwise, they were considered "general" stream students. Vocational stream was defined solely by BB002. This method yielded the following estimates:

	Academic	General	Vocational
Public	41.4%	36.0%	22.5%
Catholic	75.8%	17.0%	7.2%
Private	70.5%	25.3%	4.2%

These estimates are very close to the principals' estimates. One should remember that many students do not declare their high school program at the sophomore level; they carry some academic courses, but don't commit themselves to long-range college plans. In interpreting the analysis in Part II one should think of academic stream and general stream as a "college bound"/"not college bound" distinction.

9. The same five covariates were used as in Part I.

10. In view of the results of Part I, the adjusted differences were determined using non-parallel regression lines. Differences are then a function of the family background vector X:

$$\Delta Y_o = \alpha_c - \alpha_p + (\beta_c - \beta_p) X_o$$

The differences reported were at the private mean vector. The 95 percent confidence intervals on the estimated reading scores are 11.285 $\pm$ .725 for Catholic students. One should note that for students within each academic stream the differences in regression slopes are not as great--an ANCOVA model fit for each academic stream would be appropariate ($\beta_c = \beta_p$). Whether the differences are reported at the public school mean vector, the private school mean vector, or in the centre of the data, they are not significant for academic stream students.

11. Searls, D. T. Personal communication, October 21, 1981.

12. These differences were also calculated at the private school mean. At the public school mean they are slightly larger (.844 for reading, 2.121 for mathematics). A further analysis using ANCOVA and imputing some missing values yielded slightly lower estimates (.431 for reading, 1.504 for mathematics).

13. Heckman, J. J. "The Common Structure of Statistical Models of Truncation, Sample Selection, and Limited Dependent Variables and a Simple Estimator for Such Models." Annals of Economic and Social Measurement 5 (1976): 475-492.

14. Report of the meeting to review the statistical methodoloigy of the report Private and Public Schools at the National Academy of Sciences, Washington, D. C. July 23, 1981.

The minutes (Note 5) state that the public school scores increased by about .3. I have assumed that Coleman is referring to the sophomore 8 item reading test which has a standard deviation of 2.0.

APPENDIX 1

ANCOVA Results -- Sophomore Reading

Variable	Coefficient	SE	t	CORRELATION MATRIX Z	X_1	X_2	X_3	X_4	X_5
Intercept	7.207	.100	72.154**						
Treatment (Z)	2.421	.416	5.826**		.088	.098	.082	-.039	.004
Income (X_1)	0.148	.020	7.339**			.352	.286	-.145	-.090
Father Ed (X_2)	0.276	.015	18.577**				.542	-.095	-.098
Mother Ed (X_3)	0.206	.017	12.159**					-.020	-.083
Black (X_4)	-2.397	.110	-21.796**						-.081
Hisp (X_5)	-2.026	.127	-15.941**						
ZX_1	-0.186	.079	- 2.335*						
ZX_2	-0.091	.051	- 1.786						
ZX_3	-0.070	.056	- 1.238						
ZX_4	1.361	.553	2.463*						
ZX_5	.509	.462	1.101						
n = 14258	R^2 = .1517		s = 3.548						

* p < .05

**p < .01

APPENDIX 2
ANCOVA Results -- Sophomore Mathematics

Variable	Coefficient	SE	t	CORRELATION MATRIX Z	X_1	X_2	X_3	X_4	X_5
Intercept	14.294	.185	77.465**						
Treatment (Z)	5.645	.765	7.383**		.088	.099	.084	-.039	.004
Income (X_1)	.453	.037	12.108**			.354	.288	-.147	-.090
Father Ed (X_2)	.540	.027	19.677**				.542	-.096	-.099
Mother Ed (X_3)	.416	.031	13.253**					-.022	-.085
Black (X_4)	- 5.175	.204	-25.413**						-.081
Hisp (X_5)	- 3.911	.234	-16.688**						
ZX_1	- .264	.147	- 1.802						
ZX_2	- .310	.094	- 3.280**						
ZX_3	- .265	.104	- 2.544*						
ZX_4	1.044	.852	- 0.335						
ZX_5	- .285	1.018	1.025						

n = 14139 R^2 = .1895 s = 6.526

* p < .05
** p < .01

APPENDIX 3

I. Principal Components Analysis on Background Variables for Sophomores

Variable	Eigenvectors				
	1	2	3	4	5
BB101	.493	-.139	-.221	.823	-.100
BB039	.610	.021	.192	-.221	.736
BB042	.577	.108	.337	-.318	-.664
BLACK	-.153	.745	.528	.370	.080
HISPANIC	-.167	-.643	.722	.189	.025
Eigenvalues	1.85	1.09	.902	.707	.448

II. Principal Components Regression Results

Variable	Coefficient	SE	t
Public			
Intercept	19.839	.059	334.98
Prin 1	2.143	.044	48.90
Catholic			
Intercept	21.872	.181	121.10
Prin 1	.939	.123	7.65
Public: n = 12682	R^2 = .1587	s = 6.66	
Catholic: n = 1457	R^2 = .0390	s = 6.35	

BIBLIOGRAPHY

Alexander, K. A. and E. L. McDill. Selection and Allocation Within Schools: Some Causes and Consequences of Curriculum Placement. American Sociological Review, 1976, 41, 963-980.

Davis, S. A. and E. J. Haller. Tracking, Ability and SES: Further Evidence on the "Revisionist-Meritocratic" Debate. American Journal of Education, 1981, 89, pp. 283-304.

Meyer, R. H., and D. A. Wise. High School Preparation and Early Labor Force Experience. Working Paper No. 342. National Bureau of Economic Research, 1050 Massachusetts Avenue, Cambridge, MA 02138, 1979.